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THE COST OF DEFENSE ALTERNATIVES

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This article, used in the course for senior military officers and civilian executives, develops the concept that cost is what one must give up to get what one wants. Additionally, the various uses ot the myriad ot costs in decision making and budgeting is discussed.

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THE COST OF DEFENSE ALTERNATIVES

Costs depend upon alternatives. Costs are alternatives.

- Bickner, "Concepts of Economic Cost"

Making informed and reasonable decisions about how resources will be allocated for our country's defense is a complex but important business. Since the instruments for our national security are obtained with scarce public resources it is imperative that the defense executive prudently regard the costs of the possible choices. Cost may not always be the dominant factor in a defense decision, but it must always be addressed.

The objective of this paper is to provide an executive level overview of the concepts of cost. An understanding of the general ideas about to be discussed is important for two reasons. First, application of these concepts will help one more thoroughly investigate the ramifications of the options available in a decision. Second, cost terms and procedures are used (or misused) extensively throughout the defense establishment. Learning them is essential to communicating decision thoughts with others. This paper explores various notions of cost by answering four questions: (1) What does cost mean? (2) What types of cost should be recognized in defense decisions? (3) How are costs estimated? (4) How can costs be used to make and follow up on decisions about defense resources?

THE MEANING OF "COST"

The term cost has many meanings, many of them ingrained in our day to day life. "Like so many common words, cost is used differently in different contexts, differently by different people, and usually in vague terms."[1] For these reasons, we should explicitly define the term. Let us do this in general, and then for specific cost categories.

The dictionary refers to cost as, "an amount paid or required for a purchase; a loss or penalty; detriment." This definition is not particularly helpful. The DoD directive that outlines policy guidance on Cost Analysis does not define cost per se although the implication is that cost refers to the resources required to achieve stated objectives.[2] The Appendixes of both the Air Force and Navy's Economic Analysis Handbooks do however share a common definition of cost: "The value of things used up or expended in producing a good or a service. Also whatever must be given up in order to adopt a course of action."[3] The essence of the meaning of cost is that it represents what you must give up to get what you want. In the context of decision making, let it then suffice to say that,

COSTS REPRESENT RESOURCES TO BE CONSUMED AND/OR OTHER OPPORTUNITIES FOREGONE BY THE CHOICE OF AN ALTERNATIVE.

COST CATEGORIES

More precise meanings of cost are dependent on other modifying words comprising a term that includes cost. For example, the Navy Economic Analysis Handbook lists three pages of definitions using cost combined with other words. The definitions include everything from "actual cost" to "variable cost."[5] (Excerpts from that Glossary are attached as Appendix A). While an executive level view of costs for decision making need not be that exhaustive or technically detailed, it is important to be sensitive to some of the more frequently used categories of cost. If one cannot recognize the meaning of costs in the various forms that they are encountered, one cannot hope to use all pertinent information when to comparing alternatives, much less communicate a thorough decision process to others. What follows is a brief discussion of some of the useful ways in which cost can be expressed.

Dollar Costs

It is often said that money is not the only thing in life - but it is well ahead of whatever is in second place. This statement is really a deceiving one, for . . . "Money is not first, or second, or third in a list of the important things in life. Money is a means for attaining some of the important things. To the extent that it actually can procure them, money can be a proxy for them, and dollar costs can then be used as a meaningful measure of real costs."[6]

For those of us who think primarily in terms of real life tangible resources - i.e. people, fuel, aircraft, ships, etc. it is obvious that dollar costs are usually neither a complete nor an accurate measure of costs. However, just because "dollars aren't everything," we cannot treat them lightly or ignore dollar costs. There are various ways that dollar costs can be expressed. The four different categories we shall discuss are all related to money being valued over time: life cycle costs, current and constant dollar costs, and present value costs.

o Life Cycle Costs. This concept represent an appreciation for the total resources consumed over the entire life span of a system or project. It is part and parcel with the "systems" concept discussed in earlier Defense Analysis sessions. In Defense, the most typical components of life cycle cost for weapons systems are research and development (R&D), procurement (investment) and operations and maintenance (O&M) costs. Usually, the dollar value of life cycle costs would vary over time, something like depicted in figure 1. Note that these components combine to equal total life cycle costs.

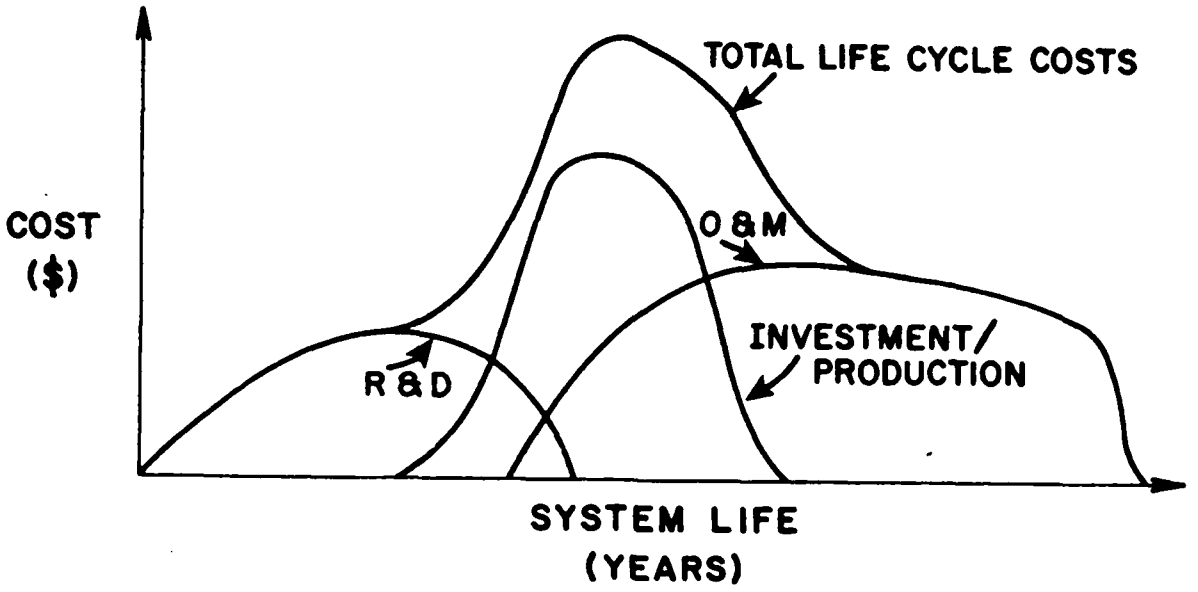

Figure 1

Life Cycle Costs

Sometimes life cycle costs can be offset by monetary benefits. For example, consider an alternative that proposes the leasing of a machine in lieu of continuing operations with an old, worn out government owned machine. If this alternative was chosen, we might foresee a cash inflow for the government by the (salvage) sale of the old machine. Similarly, it may be estimated that an alternative will have some terminal or residual value at the end of its mission life. An economic analysis of the cost of such alternatives could reduce life cycle costs by these monetary benefits. As implied, life cycle costs, offset as they might be by any benefits, are a way to describe significant portions of the resources required by defense projects. Life cycle costs should be described in two dimensions - as the sum of the component costs (R&D, Procurement, O&M) and with respect to time.

o Current Dollars: Costs and prices change over time. Purchasing value that considers the impact of the rise in general price levels (inflation) is measured in current dollars. For example, if it cost $1.00 for a widget in "1967 Current Dollars" and there was a 10% annual price increase, you would pay $1.10 a year later, using "1968 current dollars." The costs articulated in the Five Year Defense Plan (FYDP) are expressed in estimates of current dollars. An Oliver Hazard Perry class frigate might have cost $65 million (1973 current dollars) in 1973 and the same ship

cost $100 million in 1976 (1976 current dollars), the difference reflecting the inflation from '73 to '76. In that current dollars represent the exact amount of a past cost, or an estimate of the actual expected future obligation, they are useful and meaningful. In the evaluation of alternatives, the use of current dollars is severely limited. This is because one cannot compare current dollar costs from different years because they represent different values.

o Constant Dollars. We can compare the dollar costs for different years by expressing them in constant dollars. Constant dollars are cost terms with price changes removed. They reflect constant purchasing value, in terms of the actual price from a previous (base) year. So if a widget actually cost $1.00 in 1967, the same widget would also be valued at $1.00 in 1968 if we were measuring cost in 1967 constant dollars. Likewise, the cost of that frigate procured in 1976 would be expressed as $65 million 1973 constant dollars if its real value didn't increase since 1973. More than likely, however, the constant dollar cost of that frigate did increase from 1973 to 1976 because of factors other than inflation. And herein lies the benefit of using constant dollars. If the frigate's cost was $75M (1973 constant $) in 1976, we can see that the real increase (not due to inflation) in the cost of the ship between 1973 and 1976 is $75-65 = $10M, measured in 1973 constant dollars. Constant dollars then provide a common measure that can be compared, regardless of the year within which the cost occurs.[7]

o Present Value Costs. Few will argue with the idea that there is a time value to money. Bickner puts forth a very clear explanation of why we must account for the difference some costs have because of time.

> Time is valuable. Indeed, few things are more valuable, whether we are thinking about our personal lives, or a military campaign, or business investments, or farming, or the development of new military capabilities, or national economic and social programs. And yet the value of time is often forgotten, particularly whenever someone compares dollar expenditures this year with those of next year and the year after, as if all of the dollars were equal . . . They are not. No military officer would suggest that a reserve infantry battalion arriving at the front line next week is equivalent to a battalion arriving today. No shipbuilding contractor would admit that construction materials arriving next month are equivalent to those arriving this week. Resources on hand today are usually worth more than identical resources deliverable tomorrow. Consequently, dollars with which we can buy resources today are worth more than dollars available tomorrow. Thus, before we can meaningfully add together dollars spent or received in different periods, we must "discount" future dollars, for they are worth less than (today's) dollars.[8]

By discounting future costs, we reduce them to a "present value," an expression that reflects their worth now. The procedure for discounting is simple, although the choice of a discount rate can be very difficult. Discounting is really just the reverse of the procedure for compounding interest. Here's an example provided by Bickner:

> If a local savings bank will give us 1 dollar next year for every 90 cents we deposit this year, or if the bank will give us 90 cents today in return for a promise to pay 1 dollar next year, then we might reasonably adjudge a dollar next year to be worth only 90 cents on hand today. We might "discount" future dollars at a rate of 10 percent per annum. What we mean is this: A dollar available next year will be judged as worth only 90 percent as much as a dollar available today. Similarly, a dollar available 2 years from today will be judged as worth only 90 percent as much as a dollar available next year (or 90 percent x 90 percent of a dollar on hand today) and so on. By discounting the value of future dollars in this way we can reduce all dollars into their "present value" equivalent, and then we can compare these dollars sensibly.[9]

Consider the time dimension of the life cycle costs discussed earlier. Applying present value comparison would mean that the constant dollar estimated to be spent for O&M in 10 years would be worth considerably less than the constant dollar cost incurred this year for R&D or procurement. How much is it worth to the Secretary of Defense to postpone certain outlays for a year? What discount rate should be applied to future dollars so that they can be sensibly compared with current dollars?[10] This question will not be debated here, although it is an issue the decision maker must deal with if the costs of possible alternatives differ over time. Current DoD policy, based on guidance from the Office of Management and Budget, is to use a 10% rate.[11]

Other Costs

Dollars are rarely a full and valid measure of the cost of defense alternatives. Other types of costs are often useful, simpler and perhaps equally pertinent to the decision. Many of these are not expressible in dollar terms.

Think about some of the defense systems that you have had experience with. What resources did they consume? Ships burn fuel, expend ordnance and require inputs of trained officers and men. Perhaps some of these can, in certain instances, be meaningfully measured in terms of dollars. If we are at war, would it be proper to measure the cost of weapons' ammunition by the dollars it would take to produce them? The physical resources themselves might be a more direct and appropriate measure of cost in such a case. How about the size of the berth a ship needs alongside a pier, or the deck space a carrier aircraft requires? These are

significant values not easily expressed in, or comparable to, dollars. A thorough examination of defense alternatives needs to identify such costs.

Relevant Costs

Let's try to distinguish between the costs that are/are not pertinent to the decision. In the context of decisions yet to be made, it is submitted that:

> RELEVANT COSTS ARE THOSE THAT ARE PERTINENT TO THE DECISION BECAUSE THEY WILL SERVE TO DISTINGUISH AMONG ALTERNATIVES AND ARE WITHIN THE PURVIEW OF THE DECISION MAKER.

Relevant costs lie in the future, not in the past. Suppose, for example, that we want to build a park for Navy people and their dependents. One alternative is to develop the park on land acquired several years ago for the purposes of building a supply center that was never constructed. In this decision, the cost of purchasing that land is no longer a relevant factor. Costs that have already been incurred are costs resulting from past decisions.[12]

There is an implication in this definition that to be relevant to the decision, information must be different with respect to the alternatives. This is only partially true. In our Navy park example above, the cost of recreational equipment might be common to all alternatives. It would not serve to distinguish among the choices and hence would probably not be an estimate that contributed to the choice. This notion is however not altogether correct because some common costs may need to be considered to clarify the consequences of alternatives. If we were on a constrained budget, necessary equipment costs would impact on other aspects of the decision. The point is that as we evaluate alternatives, the focus should be on that which differentiates among the choices, given the situation.

The final caveat to this definition of relevant cost relates to limiting our analysis to the span of influence of the decision maker. By considering only that which falls under the control or interest of the decision maker, we necessarily bound the scope of the search for cost information. If the Base Commander is going to make the decision on the park location, the decision process need not look beyond the resources controlled by or of interest to him.

External Costs

The concept of external costs comes from the economic theory of the firm. "Externalities" occur therein when not all the costs of production are imposed on the producer.

> Fairly standard examples of external costs include the adverse affects on flora and fauna caused by cutting down trees in a forest or the increase in the mosquito population by the creation of artificial lakes and other ecological repercussions that ultimately affect the welfare of the people. The offense given by the erection of a building which interferes with television reception is a cost to those who must buy a special antenna. . . . The number of external costs in the real world are virtually unlimited.[13]

In defense decision making, we can distinguish between what is internal and what is external by the a definition of the system with which the decision is primarily concerned. Then viewing the relationship of that system to its environment, conclusions can be made about the relevance of "externalities."

Consider a "carrier based logistics" system. Its objective is to provide a Carrier Battle Group with personnel and light cargo delivery. Internal costs for this system would include all the resources consumed - personnel, fuel, aircraft, etc. - while achieving that objective. Suppose one of the proposed alternatives for this system included the use of an aircraft normally employed in the Anti-Submarine Warfare (ASW) mission. Choice of this alternative would entail an external cost in the form of the loss of some ASW capability. Would this external cost be relevant to the decision? Yes it would be if the decision maker were the CVBG Commander, because both the logistics and ASW system fall under his purview.

This distinction, between costs that are either internal or external to the decision, can be helpful in several ways. First, by looking at the external world, our attention may be drawn to pertinent costs otherwise overlooked. We should consider the consequences of our decisions on others. Categorizing costs by these internal/external notions may also be helpful in judging the relative value of the costs. Generally, we would view the value of the primary resources consumed by a system (the internal costs) to be greater than external, but somewhat pertinent costs. Similarly, it can be helpful to identify those costs, real as they might be, that are felt to be beyond the limits of our concern (i.e. external and irrelevant). Often the recognition of external costs will point out difficulties that should be expected in implementing decisions, like those the Navy experienced burying submarine communications antennas in the Midwest.[14]

SOURCES OF COST ESTIMATES

In terms of the concepts just developed, the defense organization is well staffed to project internal dollar costs. Cost analysts and budgeteers exist in all levels of the defense establishment. Each of the services has cost estimating offices. Project managers for specific weapon systems also assemble estimates of the components of life cycle costs. Nevertheless the accurate

projection of costs is really a problem, especially in the procurement of weapons systems and in the analysis of other large and complex programs. Because of this, unique estimating methodologies have been developed. There are at least four basic approaches to estimating the costs of defense projects. These are the industrial engineering, parametric, analogy, and the top down methods. An awareness of the general principles of these methods, along with some pitfalls and perspective, can help one understand their utility.[15]

Industrial Engineering Method. Industrial engineering is referred to as the "bottom up" or "grass roots" approach. It consists of a consolidation of estimates from various separate work segments into a total project estimate. A familiar example is that of an architect estimating the cost of a new building. He may estimate the construction cost as being equal to the sum of those from the structural, electrical, plumbing, heating and other aspects of the project. Each subestimate may have numerous labor, materials, and equipment components.

The bottom up method represents the most thorough approach, with estimates from experts on all details. It is also specifically tailored to individual project requirements. However, industrial engineering can be overly pessimistic because of redundant contingencies in each estimating package. It can also result in underestimates because of items of work omitted, unrealistic assumptions or inadequate allowances for unexpected conditions or schedule delays. Another drawback is that this grass roots type of estimate is not easily compiled on short notice.

Parametric Cost Estimating. In this method, the total cost of alternatives is based on relationships to parameters, or characteristic elements. Examples include dollars per square foot for building a house, and dollars per ton of displacement for a nuclear powered submarine. In other words, a functional relationship must be established between the total cost of an alternative and the various characteristics or parameters of the system. The aim of this type of cost analysis is to develop a valid cost estimated relationship (CER). CERs are frequently derived through the technique of regression analysis, which relates cost as a dependent variable to physical or performance characteristics, which are independent variables. In a simple example, a CER developed for construction of a Unaccompanied Enlisted Personnel Housing (UEPH) project might display a linear relationship on a graph showing square footage of living space (independent variable) and dollar cost (dependent variable). The Naval Air Systems Command estimates cost with the parametric variables of weight, speed, power, density and thrust.[16]

Parametric cost estimating is the most commonly used method in DoD. Its primary advantage is that it represents comparison with realistic actual historical experience. On the negative side, parametric costing does tend to be overly pessimistic because of failure to take into account improvements or lessons

learned from past mistakes. Parametric cost estimating is also difficult to tailor to individual circumstances or accommodate differences from the comparison data.

Analogy Method. When more formal techniques cannot be applied, because detailed data does not exist, the analogy method may be used to estimate costs by making direct comparisons with historical information on similar existing systems or their components. For example, land parcels could be priced based on the sales of similar plots. Many low cost defense equipments are costed by the analogy method as are ship operating and support expenses.[16] A major caution in using the analogy method is that it is basically a judgment process and, as a consequence, requires a considerable amount of experience and expertise if it is to be done successfully.

Top Down Approach. Similar to the analogy method, top down estimates are made by a general assessment of what the project "should cost." They are based primarily on funding availability. This method can be useful because it attempts to assign value based on what is considered acceptable at a particular time period. "Should costs" can however represent more wishful thinking than rational cost estimate. In fact, top down tends to be overly optimistic because of ignoring details of specific requirements as well as potential difficulties. The Naval Material Command has used "should cost" analysis for the AEGIS weapon systems, the latest ship sonar, and the air-to-air missile used on the F-14 fighter.[16]

Caveats. The preferred approach to cost estimating would be to combine several, if not all, of these methods. Of course, this could become a costly process itself. Even so, the data generated are only estimates, not certain projections of the actual costs of alternatives. Further, these estimates do not represent hard, unique values. They are the results of statistical sampling and should be reported in terms of measures of central tendency and variation (e.g., mean and standard deviation).[17] Finally, all of these cost estimating devices tend, by design, to overlook "other" than life cycle dollar costs.

USE OF COST

There are various ways that the concepts of costs are applied in the practice of deciding about defense resources. Let's discuss how costs can and should be treated in the various parts of a decision making process: (1) in the analysis leading to a decision being made, (2) when implementing the decision, and (3) while verifying decisions after they are made and installed.

Economic Analysis

The Assistant Secretary of Defense (comptroller) has defined Economic Analysis as "a systematic approach to the problem of choosing how to employ scarce resources and an investigation of

the full implications of achieving a given objective . . . (and DoD) Policy . . . (is that) . . . an economic analysis is required for proposals which involve . . . two or more options . . . considering costs, schedule and performance. . . ."[18]

Cost is half of this equation. Cost is the concern in this paper. The earlier discussion of cost categories should prove to be a helpful guide as all the costs of alternatives are developed. Total relevant life cycle costs, offset as they might be by any benefits, should be considered. Other costs obviously should be explored. This includes those not measured in dollars and those beyond the immediate system of concern but still of interest to, although not necessarily under the control of, the decision maker.

At this ("analysis") stage of the decision process, comparison of dollar costs should use constant dollars. Inflation can, and should, be factored out of the evaluation if we think that general price increases will affect all alternatives equally. If we have reason to believe that any particular component cost of an alternative will experience unusual price increases, we would want to explicitly account for such a difference in our analysis. This could be done by escalating those, and only those, peculiar costs. Finally, if the dollar costs of alternatives differ with respect to their dollar outlay over time, their constant dollar cost streams should be reduced to their present value for comparison.

Other costs may require special executive level attention. This is especially true because of the institutional emphasis placed on those measured in dollars. Evaluation of "other" costs will of necessity be a subjective assessment. This should include a judgment of how important the value of these costs are with respect to those measured in monetary terms.

Budgeting

Decisions about defense resources are implemented by inclusion in the Budget. It should be recognized that costs receive significantly different treatment in "budgeting" than they do in "analysis."

Budgeting in the context of the DoD Planning, Programming and Budgeting system involves tying mission needs to resource requirements. It is a process that produces a Five-Year Defense Plan, with proposed programs in terms of dollars to be spent in the future. So budget dollars reflect their value in the year they are expected to be expended. Inflation must then be factored in. Budget dollars values are expressed in "then year" dollar terms which we referred to earlier as "current dollars."

For example, if in 1984 we are budgeting for 1989, we will somehow have to take into account expected price increases between now and then. We want to do this with as much foresight as possible. "Clearly defense budgets eroded by unforeseen inflation will fall short of their goals, just as an economy weakened by too much

inflation will lose its productive strength."[19] There are offices in the DoD that routinely provide the guidance for how much inflation to factor in. So, budgeting involves estimating costs and then escalating those costs to "then year" or "budget dollars" in accordance with the latest DoD guidance.[20] This business of using cost estimates to build budgets is often referred to as "costing".

Program Evaluation

The extension of the defense decision process that deals with following up on decisions is referred to as "Program Evaluation" (the "E" in PA&E). "Program Evaluation is economic analysis of on-going actions. . . ."[21]

In this later stage of the decision process we are verifying the decision by asking, "are we satisfied?" Among the more detailed questions that should be asked include "are objectives being achieved as the result of our decision?" and "at what cost?" Again, as in the analysis of proposed programs, all relevant costs must be evaluated. This will require a thorough tracking effort. However, unlike pre-decision analysis, this verification of decisions uses actual costs which have been observed. Defacto current dollar outlays should be tallied and reduced to constant dollars so they can be measured in common terms for evaluation. Costs measured in other than dollars and external costs should likewise be subjectively assessed.

In sum, we find that similar cost estimates are treated differently in the analysis of alternatives than they are in budgeting. The decision process leading to a choice should compare relevant constant dollar costs, perhaps in present value terms. Budgeting applies inflation factors to cost estimates and expresses costs in current dollar terms.Post decision evaluation is based on the actual costs experienced.

SUMMARY

Costs are indeed the negative consequences of decisions. They represent what must be given up to get what one wants. The decision process should seek to identify, measure and then evaluate the benefits forgone by choosing one course of action, one policy or program, rather than another. When we use dollars to estimate costs we are attempting to identify required resources as well as the alternatives they represent. Time is valuable, and the decision process should not treat dollar expenditures as if they were equal no matter when they occur. Only rarely will dollar expenditures be a full and completely valid measure of cost and a complete decision process accounts for all relevant costs. Relevant costs depend upon the sphere of influence and the breadth of interest of the decision maker. Relevant costs are those costs that depend upon the choice made, given the choices available.

NOTES AND REFERENCES

Footnotes

1. E.S. Quade, "Costs" in Analysis for Public Decisions, Elsevier, New York, 1975, p. 124

2. Assistant SECDEF (Comptroller), Department of Defense Instruction 7041.3 of 18 October, 1972, "Economic Analysis and Program Evaluation for Resource Management."

3. Lorraine Morris, Economic Analysis Procedures Handbook (AF Pamphlet 178-8) HQ USAF, 19 May 1981, p. A2-1 and Navy Economic Analysis Handbook, (NAVFAC P-442), Naval Facilities Command, July 1980, p. G-6.

4. Quade, "Costs," p. 124.

5. NAVFAC P-442, p. G-6 to G-8.

6. Bickner, R.E., "Concepts of Economic Cost" in G.H. Fisher (ed.), Cost Considerations in Systems Analysis. Elsevier, New York, 1971, p. 49.

7. If you would like to pursue the concepts of constant and current dollars further, NAVFAC P-442 offers many exercises and further discussion covering the use of these two dollar measures.

8. Bickner, "Concepts of Economic Costs", p. 51.

9. Ibid., p. 51 & 52. For those who might like to pursue present value further, descriptions and practical examples of its use are well detailed in the Navy and Air Force Economic Analysis Handbooks cited in 3 above.

10. It is important to realize that the present value calculation should be based on constant dollar estimates. (Cost measures which have the effect of inflation removed.) Uninformed executives often think that we "discount because of inflation and that we must "inflate" constant dollars before we discount them." That's not the case; as discussed earlier we discount primarily to account for the value money has over time. Using constant dollars allows one to set aside the issue of inflation.

11. DoD Instruction 7041.3, p. 13, 14.

12. Adapted from Quade, "Costs," p. 129.

13. Quade, "Costs," p. 130.

14. Some noted decision theorists have a different view of what constitutes an external cost. Bickner holds that external costs are those that fall beyond the boundaries of the decision

maker's interests or beyond the scope of his organization (see "Concepts of Economic Cost," p. 37). Quade, who borrows heavily from Bickner's ideas, defines external costs similar to the way Bickner does (see "Costs," p, 130). The authors' difficulty with their definition of external cost it that it makes all external costs irrelevant to the decision. Thus, there would be little utility in conceptualizing the otherwise useful category of external costs.

15. The discussion of cost estimating methods is adapted from NAVFAC P-442 and Eugene L. Scott's "The Cost Growth Phenomenon," National Contract Management Journal, Winter 1983.

16. These cost estimating examples were taken from the DoD Cost Analysis Symposium Service Meeting, 26 June 1984.

17. For example the estimate of the cost of an aviation system component could be expressed as $200 (mean value) with a standard deviation of $50. This means we could expect the real cost to be between $150 and $250, 68% of the time.

18. DoD Instruction 7041.3, p. 2, 3.

19. Jack R. Borsting, "Shaping the Defense Budget: The Role of Economic Analysis," Defense Management Journal, Second Quarter 1983.

20. OMB, OSD and NAVCOMPT pricing guidance is typically reviewed and updated twice a year (Source: CNO Memo POM 86-9 27 Oct 1983).

21. DoD Instruction 7041.3, p. 3.

Additional Reference

Blanchard, Benjamin S. Logistics Engineering and Management, 2nd ed. Prentice-Hall. (Appendix A, "Cost Analysis Data" covers cost categories, cost estimating, discounting, inflation, learning curves and cost models.)

APPENDIX A

DEFINITIONS OF COST ASSOCIATED TERMS

Source: Navy Economic Analysis Handbook (NAVFAC P-442)

constant dollars - Computed values which remove the effect of price changes over time. Derived by dividing current dollar values by their corresponding price indexes based on a time period specified as 100. The result is a series as it would presumably exist if prices were the same over time as in the base year; in other words, as if the dollar had constant purchasing power. Thus changes in such a series of price-adjusted output values would reflect only changes in the real volume of output.

cost, actual - Cost incurred in fact as opposed to "standard" or projected costs. May include estimates based on necessary assumptions and proportions concerning outlays previously made. Excludes projections of future outlays.

cost allocation - The portion of joint or indirect assets assigned to a particular objective such as a job, a service, a project, or a program.

cost analysis - Determining the actual or estimated costs of relevant spending options. An integral part of economic analysis and program analysis. Its purpose is to translate the real source requirements (equipment, personnel, etc.) associated with alternatives into estimated dollar costs. The translation produces direct one-dimensional cost comparisons among alternatives.

cost, applied - The value of goods and services used, consumed, given away or lost by an agency during a given period regardless of when ordered, received or paid for. Generally, applied costs are related to program outputs so that such costs become the financial measures of resources consumed or applied in accomplishing a specific purpose. For operating programs, such costs are related to the value of resources consumed or used; for procurement and manufacturing programs, they are related to the value of material received or produced; for capital outlays, they are related to the value of assets put in place; for loan activities, they are related to assets required.

cost, average - The quotient of total cost divided by corresponding output. Also, the sum of average fixed cost per unit of output plus average variable cost per unit of the same output.

cost/benefit - A criterion for comparing programs and alternatives when benefits can be valued in dollars. Refers to the ratio, dollar value of benefit divided by cost. Provides comparisons between programs as well as alternative methods. Useful in the search for an optimal program mix which produces the greatest number of benefits over costs. See: Cost effective alternative; Present value.

cost/benefit analysis - Comparing present values of all benefits divided by those of related costs, where benefits can be valued in dollars the same way as costs in order to select the alternative which maximizes the present value of the net benefit of the alternative or program, and to select the best combination of alternatives or programs using the benefit/cost ratio. See: Cost effective alternative.

cost, direct - Any cost which is identified specifically with a particular final cost objective or goal. Varies with level of operation.

cost effective alternative - That alternative which . . . (1) Maximizes benefits and outputs when costs for each alternative are equal (the most effective alternative); or (2) Minimizes costs when benefits and outputs are equal for each alternative (the most efficient alternative); or (3) Maximizes differential output per dollar difference when costs and benefits of all alternatives are unequal.

cost elements - Cost projected for expected transactions, based upon information available. Does not pertain to estimates of costs already incurred. See: Cost, actual.

cost estimating relationship (CER) - a numerical expression of the link between a characteristic, a resource, or an activity and a particular cost associated with it. The expression may be a simple average, percentage, or complex equation derived by regression analysis which relates cost (dependent variable) to physical and performance characteristics (independent variable). For example, estimated costs of an aircraft airframe (dependent variable) might be determined, using regression analysis, to be a function of airframe weight, delivery rates, and speed (independent variables). The CER shows how the values of such independent variables are converted into estimated costs.

cost, fixed - Cost incurred whether or not any quantity of an item is produced. Does not fluctuate with variable outputs. For example, the rental cost for a manufacturing facility might be treated as fixed cost because it does not vary with output.

cost, inputed - A cost that does not appear in accounting records and does not entail dollar outlays.

cost, incremental - Increase in costs per unit increase in program activity. Also the additional cost needed to make a change in the level or nature of output. If incremental cost per ton is $100 for an increase in production from 100 to 150 tons per month but only $75 per ton for an increase in input to 200 tons per month, the incremental cost in total operations would be $5000 for adding 50 tons of output and only $7500 for adding 100 tons per month.

cost, indirect - Any cost, incurred for joint objectives, and therefore not usually identified with a single final cost objective.

Includes overhead and other fixed costs and categories of resources other than direct costs, required to add up all segments of total cost. For example, the cost of bookkeeping is often not identified with a single type of output.

cost, induced - All uncompensated adverse effects caused by the construction and operation of a project or program, whether tangible or intangible. For example, deterioration in environmental quality resulting from a water resource project. See: Externalities.

cost, joint - Cost of producing two or more outputs by a single process.

cost, marginal - Change in total cost due to a change in one unit of output. It is a special case of the more general term, incremental cost. Theoretically, a firm will maximize profits (or minimize losses) by increasing output until marginal cost equals marginal revenue. At that point, any additional output will incur a cost greater than the added revenue and any reduction in output will reduce revenue by more than the reduction in costs.

cost, opportunity - The benefits that could have been obtained by the best alternative use of resources which have been committed to a particular use. The measurable sacrifice foregone by foresaking an alternative investment.

cost, social - The total costs of an activity both public and private. For example, health effects of auto pollution are a component of the social cost of automobile transportation.

cost, standard - A predetermined cost criterion. A basis for pricing outputs, evaluating performance, and preparing budgets. May be expressed as unit cost for an item or a component, or total cost for a process, a project or a program.

cost, sunk - Non-recoverable resource that has been consumed as the result of a prior decision. Sunk costs are not altered by a change in the level or nature of an activity and have no bearing on current investment decisions.

costs, total - Sum of fixed and variable costs at each level of output during a specified time period.

cost, undistributed - Costs incurred but not allocable to specific projects or programs, such as overhead costs for staff personnel working on several projects or programs.

cost, unit - Cost of any type per unit of output.

cost, variable - Cost that varies with the quantity of output produced.

current dollars - Dollars that are current to the year of their expenditure. When past costs are stated in current dollars, the figures given are the actual amounts paid out. When future costs are stated in current dollars, the figures given are the amounts which will be paid including any amount due to projected future price changes.

discount factor - The multiplier for any specific discount rate which translates expected cost or benefit in any specific future year into its present value.

discount rate - The interest rate used in calculating the present value of expected yearly costs and benefits. Represents the price or opportunity cost of money. See: Present value.

discounting - A computational technique using an interest rate to calculate present value of future benefits and costs. Used in evaluating alternative investment proposals that can be valued in money. Reflects private sector investment opportunity cost as well as preference for current over future dollar incomes.

externalities - Benefits and costs (economics or diseconomies) that affect parties other than the ones directly involved. Sometimes referred to as spillovers. An external economy is a benefit received by one from an economic activity of another for which the beneficiary cannot be charged. An external diseconomy is a cost borne or damage suffered consequent to the economic activities of others for which the injured is not compensated. For example, a city downstream benefits from, but does not pay for, a water pollution control program instituted upstream.

inflation - Decrease in the value of money due to rising prices.

learning curve - A curve which describes the set of points conforming to the observed phenomenon that unit costs reductions are a constant percentage decrease for each doubling of the cumulative quantity produced. This means that the cost of manufacturing unit 2 will be a certain percentage less that the cost of manufacturing unit 1; the cost of unit 4 will be same percentage less than unit 2, and so on.

life cycle estimates - All anticipated costs, directly are associated with an alternative during all stages: operational, and terminal.

present value - The present worth of past or future benefits and costs determined by applying discount procedures to make alternative programs and actions comparable regardless of time differences in the money flows. See: Discounting, Discount factor, Discount rate.

present value benefit - Calculation of each year's expected monetary benefit multiplied by its discount factor and then summed over all years of the planning period.

present value cost - Calculation of each year's expected cost multiplied by its discount factor and then summed over all years of the planning period.

spillover - An economy or diseconomy for which no compensation is given (by the beneficiary) or received (by the loser). Spillover is sometimes synonymous with externality and with external economy or external diseconomy.

sunk costs - Costs which have already been incurred and will not be increased or decreased by any decision made either now or in the future. Therefore, such costs have no relevance to decisions regarding future action. For example, in making a decision as to whether a new plant should be constructed, the construction cost of the existing plant is a sunk cost.